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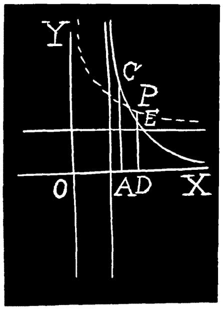
307. Proposed by J. SCHEFFER, Hagerstown, Md.

If $y^x=2$ and $x^y=3$, find x and y.

I. Solution by E. B. ESCOTT, Ann Arbor, Mich.

The solution (x, y) of these two equations, is the same as the intersection of the curves (1) and (2).



In the figure, (1) is drawn with full lines, (2) with dotted lines. We see that outside of (0, 0) there is but one point of intersection, P. If we cut the curves by a line $x=c$, it is evident that the value of y from (2) is nearer to the required value than that from (1). If we cut the curve by the line $y=a$, the value of x from (1) is nearer to the required value than the value of x from (2). A rapid approximation can then be found by taking any value of $x>1$ and solving (2) for y. With this value of y substituted in (1), solve for x, etc. If we do this for two values of x, one such that ABC is to the left of P and another such that DEF is to the right of P, we shall approach the point P from both directions and will have an upper and lower limit for the coordinates of P at each step. In this way I find the approximation

$$2.2390<x<2.23939, \quad 1.3627<y<1.36285.$$

Solved similarly by S. Lefseletz.

II. Solution by FRANCIS RUST, C. E., Allegheny, Pa.

The problem proposed by Mr. Scheffer is found in Heis' *Sammlung von Beispielen und Aufgaben, etc.,"* §106, No. 12.

$x^y=b=3$, $y^x=a=2$ makes $y=\dfrac{\log b}{\log x}$, $x=\dfrac{\log a}{\log y}$; *i. e.*, $x\log y=a$, from which is derived the transcendental equation:

$$x\log\log b-x\log\log x-\log a=0=f(x).$$

Solving same by means of Newton's method:

$$h=-\frac{f(x)}{f'(x)}; \quad f'(x)=\log\log b-\log\log x-\frac{(\log e)^2}{\log x}.$$

$a=2$, $b=3$, $\log e=0.4342945$, results: $x=2.2392498$, $y=1.3628042$.

Also solved by V. M. Spunar, G. B. M. Zerr, J. A. Caparo, A. H. Holmes, and the Proposer.